

Exhibit A

**IN THE UNITED STATES DISTRICT COURT
FOR THE MIDDLE DISTRICT OF ALABAMA**

KENNETH EUGENE SMITH)	
)	
Plaintiff,)	
)	Case No. 2:22-cv-00497-RAH
v.)	
)	CAPITAL CASE
JOHN Q. HAMM, Commissioner, Alabama)	
Department of Corrections, <i>et al.</i>)	EXECUTION SCHEDULED FOR
)	NOVEMBER 17, 2022
Defendants.)	

DECLARATION OF ROBERT JASON YONG, M.D.

I, Robert Jason Yong, declare under penalty of perjury as follows:

I have been asked by Arnold & Porter to provide an expert review on intravenous access. Specifically, in preparing this report, I have referenced textbooks, journal articles, and guidelines. I also rely on my medical training and clinical experience as an anesthesiologist. My expert opinions on the subject are set forth below. All the opinions stated in this medical report are stated to a reasonable degree of medical certainty.

I. Qualifications

I am the Chief of Pain Medicine and serve as the Medical Director of the Pain Management Center at Brigham and Women's Hospital in Boston, Massachusetts, which is affiliated with Harvard Medical School. I am on the faculty of Harvard Medical School, where I am an Assistant Professor in Anesthesia. In 2014, 2015, 2016, 2018, 2020, and 2021, I was awarded the Pain Attending of the Year Award for the Department of Anesthesiology at Brigham and Women's Hospital. Prior to this, I was an Assistant Professor at Johns Hopkins Hospital in Baltimore, Maryland, where I was awarded Outstanding Teacher of the Year, Department of Anesthesiology in 2013.

I obtained my Medical Degree from Baylor College of Medicine. I completed my residency in anesthesiology, perioperative medicine, and pain medicine at Brigham and Women's Hospital, Harvard Medical School. As a resident at Brigham and Women's Hospital, I received recognition as the Distinguished Resident of the Year and was selected as a Foundation for Anesthesia Education and Research (FAER) Practice Management Scholar. During my last year of residency, I was elected as a Chief Resident of the Anesthesiology Department. Following residency, I completed a fellowship in Pain Medicine at Brigham and Women's Hospital, Harvard Medical School. I am licensed to practice medicine in Massachusetts and double-board certified in Anesthesiology and Pain Management.

I have deep experience with the subject matter of this case. I have substantial knowledge, training, and experience in the insertion and management of intravenous catheters and medication administration. I have over 10 years of experience inserting peripheral intravenous catheters and administering medication. I have a deep understanding of physiology and pharmacology with board certification in Anesthesiology.

Attached as Exhibit A is a list of references considered in preparing my report. My CV is attached hereto as Exhibit B.

I reserve the right to supplement or amend my opinions based upon any new information or medical literature that subsequently becomes available to me. I further reserve the right to comment on any opinions offered by defendants' experts at deposition or trial. In addition, I reserve the right to discuss general concepts within the field of Anesthesiology to provide context for any of the opinions discussed in this report. Finally, I reserve the right to use graphics or demonstratives at trial to illustrate the concepts discussed in my report.

II. Background

A. Anatomy and Physiology

The human circulatory system or cardiovascular system allows the flow of blood throughout the body. The blood transports nutrients and oxygen to the tissues and carries carbon dioxide and waste products away to be metabolized or excreted. The heart serves as the main pump moving blood to the vital organs, including the heart, lungs, kidneys, liver, and brain¹.

Veins are blood vessels that carry blood to the heart while arteries are blood vessels that carry blood away from the heart. The main artery carrying blood away from the heart is the aorta which then branches into other arteries which branch into smaller arterioles and eventually into capillaries. Capillaries then flow to venules which then combine into small veins and eventually into one of two main veins, superior vena cava or inferior vena cava. The superior and inferior vena cava brings blood back to the heart. Peripheral veins are the smaller veins and can often be visualized through the skin. Central veins are the larger veins, including the internal and external jugular vein which connect to either the superior or inferior vena cava.

There are two main circuits in the cardiovascular system, the pulmonary circulation and the systemic circulation. The pulmonary circulation has the heart pump blood to the lungs which then returns back to the heart. The systemic circulation uses the heart to pump blood to the rest of the body including the heart itself, the brain, kidneys, and the peripheral tissue.

The systemic circulatory system is responsible for oxygen and nutrients to the distal parts of the human body. Medication administered to the body uses the same systemic circulatory system to spread to the target tissue where the effect of the medication may take place. Medication

¹ InformedHealth.org [Internet]. Cologne, Germany: Institute for Quality and Efficiency in Health Care (IQWiG); 2006-. How does the blood circulatory system work? 2010 Mar 12 [Updated 2019 Jan 31]. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK279250/>

taken orally must be absorbed and sometimes metabolized before entering the circulatory system.

Medication administered intravenously can be introduced directly into the circulatory system.

B. Intravenous catheters

Intravenous catheters are conduits allowing liquid medication to be introduced directly into a vein². Catheters can be placed peripherally into smaller veins or centrally into larger veins. The conduits allow medication, fluids, blood, and nutrients to be administered directly into the circulatory system.

Peripheral intravenous catheters are the most frequently used devices in hospitals with up to 70% of patients requiring insertion during hospitalization.³ First, a tourniquet is applied more proximal to the target vein to engorge the distal veins and allowing for higher success. Typically, the skin over a vein in the upper extremity is prepared using a cleaning agent such as alcohol. A hollow metal needle surrounded by the plastic cannula or catheter is then inserted through the skin and through the wall of the vein and into the lumen of the vein. The plastic catheter is then threaded off the metal needle to advance further into the lumen of the vein. The catheter is advanced until the large plastic hub reaches the skin. The hub allows the connection of the tubing and prevents the plastic cannula from going too far into the vein. The metal needle is then removed leaving behind the plastic catheter and hub which is then connected to IV (intravenous) tubing. The catheter is then secured to the skin using tape or other adhesive coverings.

Central venous catheters are larger and longer catheters that insert through the skin and into deeper and larger veins. Central venous catheters were first reported in 1929 and now an

² Beecham GB, Tackling G. Peripheral Line Placement. [Updated 2021 Aug 15]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK539795/>

³ Zingg W, Pittet D. Peripheral venous catheters: an under-evaluated problem. Int J Antimicrob Agents. 2009;34 Suppl 4:S38-42. doi: 10.1016/S0924-8579(09)70565-5. PMID: 19931816.

estimated 8 percent of hospitalized patients require central venous access.⁴ Central line placement is more involved requiring more equipment, time, and expertise. The three most common sites for central venous access are the jugular vein in the neck, the subclavian vein under the collarbone, and the femoral vein in the groin. The skin over the area is cleaned with antiseptic solution and either using anatomic landmarks or ultrasound guidance, a syringe on a large needle is inserted into the lumen of the larger vein. The syringe is used to provide negative pressure by pulling back on the plunger of the syringe. The negative pressure created is released when the needle is in the vein with venous blood filling the syringe. The syringe is then removed and a solid metal guidewire is inserted through the needle into the lumen of the central vein. If ultrasound guidance is used, ultrasound confirmation of the guidewire coursing the path of the vein is an important step before proceeding with the rest of the procedure. The needle is then removed, leaving behind the guidewire which is in the lumen of the vein and coming out of the skin. A scalpel is then used to incise the skin at the insertion point of the guidewire. This allows the larger dilator to pass through the skin. The dilator is then passed over the guidewire and is advanced until the hole in the vein created by the guidewire is widened. The dilator is then removed leaving the guidewire in place. Next, the central venous catheter is then advanced over the guidewire and into the lumen of the vein until the hub of the catheter reaches the skin. The guidewire is then removed entirely and finally the catheter is secured with sutures and dressed with adhesive coverings. Prior to usage in nonemergency situations, the catheter tip is confirmed with imaging – usually portable chest x-rays.

⁴ Ruesch S, Walder B, Tramèr MR. Complications of central venous catheters: internal jugular versus subclavian access--a systematic review. Crit Care Med. 2002 Feb;30(2):454-60. doi: 10.1097/00003246-200202000-00031. PMID: 11889329.

C. Challenges with intravenous access

Failure rates for peripheral intravenous catheters range from 35-50% with failures including phlebitis, infiltration, dislodgement, infection, and occlusion.⁵ Phlebitis is defined as inflammation of a vein and is usually associated with a blood clot inside a damaged vein. Infiltration occurs when the medication or fluid administered through the catheter seeps outside the vein and into the local tissue. This results in the medication not reaching the targeted systemic circulatory system. This can occur if the catheter is not correctly inserted into the lumen of the vein. Infiltration can also occur if the catheter is inserted correctly into the vein. If the wall of the vein is fragile, it can burst. Furthermore, if previous attempts at insertion of the peripheral intravenous catheter resulted in more proximal holes, medication can infiltrate into the local tissue surrounding the hole or holes. Given the high incidence of failures with peripheral intravenous catheters, protocols have been developed, including the Vessel Health and Preservation protocol which helps standardize practice and maintenance.⁶

Certain patient characteristics may also affect success at finding and accessing peripheral veins. For example, dark skin, pregnancy, obesity, and anxiety have been associated with increased difficulty.⁷ Anxiety creates an imbalance in our sympathetic and parasympathetic nervous systems. Increased sympathetic tone is known as the fight or flight reaction and is an involuntary reaction by human physiology. Increased parasympathetic tone is known as the rest and relaxation response by the human body. Anxiety increases sympathetic tone which results in blood flowing away from our skin and digestive system and into our muscles. The flow away

⁵ R. E. Helm, J. D. Klausner, J. D. Klemperer, L. M. Flint, and E. Huang, "Accepted but unacceptable," *Journal of Infusion Nursing*, vol. 38, no. 3, pp. 189–203, 2015.

⁶ Jackson T, Hallam C, Corner T, Hill S. Right line, right patient, right time: every choice matters. Br J Nurs. 2013 Apr 25-May 8;22(8):S24, S26-8. doi: 10.12968/bjon.2013.22.Sup5.S24. PMID: 23752501.

⁷ Lamperti M, Pittiruti M. II. Difficult peripheral veins: turn on the lights. Br J Anaesth. 2013 Jun;110(6):888-91.

from the skin results in increased difficulty achieving peripheral intravenous access. Furthermore, patients in shock or with veins damaged by previous chemotherapy or intravenous drug abuse can present difficulty. Vasospasm occurs when the wall of the blood vessel tightens making the lumen of the vessel much smaller to the point that it can restrict blood flow. Vasospasm can occur when trying to access a blood vessel and has also been linked to anxiety.⁸

During the insertion of a peripheral intravenous catheter, patients can develop a vasovagal reaction in up to 13% of patients.⁹ A vasovagal reaction occurs when the heart rate and blood pressure drop suddenly at the sight of blood or extreme emotional distress. Patients developing vasovagal reactions involuntarily develop cold, clammy skin, feel lightheaded, sweat, and can lose consciousness. In patients developing a vasovagal reaction, placing a peripheral or central venous line can be extremely difficult. Extreme emotional distress can include anxiety or nervousness over a procedure or process. In my experience as a pain physician, we have patients who undergo vasovagal reactions during the time around the procedures we perform. There are no reliable predictive factors for who will have a vasovagal reaction but extreme anxiety over a situation can precipitate the reaction.

D. Troubleshooting difficult intravenous access

In the controlled setting of optimized patients, with adequate resources and personnel, I have witnessed failed intravenous catheters with infiltration. In those cases, we have the ability to troubleshoot and replace the IV if needed. In settings where the patient is not optimized, such as

⁸ Ercan S, Unal A, Altunbas G, Kaya H, Davutoglu V, Yuce M, Ozer O. Anxiety score as a risk factor for radial artery vasospasm during radial interventions: a pilot study. *Angiology*. 2014 Jan;65(1):67-70. doi: 10.1177/0003319713488931. Epub 2013 May 8. PMID: 23657175.

⁹ Rapp SE, Pavlin DJ, Nessly ML, Keyes H. Effect of Patient Position on the Incidence of Vasovagal Response to Venous Cannulation. *Arch Intern Med*. 1993;153(14):1698–1704. doi:10.1001/archinte.1993.00410140084010

extreme distress or anxiety, shock, or trauma, failure rates are higher and can go longer without being recognized.

Surgical cutdown of the vein was previously used as a rescue to difficult intravenous access. Surgical cutdown requires a skin incision until vein is directly visualized and a catheter can be inserted under direct vision.¹⁰ This would be performed by a surgeon or physician with surgical experience. As an Anesthesiologist, we are not routinely taught how to perform this surgery. In fact, this technique has fallen out of favor given the surgical expertise required, potential for bleeding and failure to adequately visualize the vein. Especially in well-resourced healthcare systems, the need to do a cutdown is extremely uncommon.¹¹

In the peri-operative setting, we utilize, vein finding lights and ultrasound machines. Vein finding lights use near-infrared to detect and illuminate veins up to 1 centimeter deep. Ultrasound machines allow real-time guidance and visualization of blood vessels. For central venous access, the protocol at our hospital is to use real-time ultrasound guidance for placement of central lines. In 2001, the Agency for Healthcare Research and Quality recommended the use of ultrasound guidance for central line placement based on improving patient care and patient safety.¹²

With the expertise in the pre-operative preparation area, we have registered nurses who place peripheral intravenous catheters in patients who have been optimized for surgery. There are many times where the registered nurse is unable to obtain intravenous access. In those circumstances, they will call the dedicated IV team with the equipment and experience to insert

¹⁰ Chappell S, Vilke GM, Chan TC, Harrigan RA, Ufberg JW. Peripheral venous cutdown. J Emerg Med. 2006 Nov;31(4):411-6. doi: 10.1016/j.jemermed.2006.05.026. PMID: 17046484.

¹¹ Beecham GB, Tackling G. Peripheral Line Placement. [Updated 2021 Aug 15]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK539795/>

¹² Rothschild JM. Ultrasound guidance of central vein catheterization. In: *On Making Health Care Safer: A Critical Analysis of Patient Safety Practices*. Rockville, MD: AHRQ Publications; 2001; Chapter 21: 245–255. Available at: <http://www.ahrq.gov/clinic/ptsafety/chap21.htm>. Accessed February, 2008.

intravenous catheters in difficult situations. If an anesthesiologist is available, the pre-operative nurse may also call upon them to use their expertise or ultrasound guidance to place the necessary intravenous catheter.

In circumstances where the patient is not optimized or with increased anxiety, the challenges of obtaining intravenous access increase greatly. Rarely, in the situation of a controlled medical setting, accessing the peripheral vein is so difficult, we are required to perform a central line prior to inducing anesthesia. In those circumstances, we utilize real-time ultrasound guidance and confirm the tip of the catheter using portable x-ray prior to administering medication through the catheter.

My engagement is ongoing, and should any additional material information become available to me, I reserve the right to modify or supplement my conclusions and opinions.

I declare that the foregoing is true and correct under penalty of perjury, pursuant to 28 U.S.C. § 1746.

Signed on this 18th day of October 2022,



R. Jason Yong, MD MBA

Exhibit A: Materials Considered List

Alabama Department of Corrections Execution Procedures, March 2021
Beecham GB, Tackling G. Peripheral Line Placement. [Updated 2021 Aug 15]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK539795/
Bruenig, Elizabeth. "Dead to Rights." <i>The Atlantic</i> , Atlantic Media Company, 12 Sept. 2022, https://www.theatlantic.com/ideas/archive/2022/08/joe-nathan-james-execution-alabama/671127/ .
Chappell S, Vilke GM, Chan TC, Harrigan RA, Ufberg JW. Peripheral venous cutdown. <i>J Emerg Med.</i> 2006 Nov;31(4):411-6. doi: 10.1016/j.jemermed.2006.05.026. PMID: 17046484.
Ercan S, Unal A, Altunbas G, Kaya H, Davutoglu V, Yuce M, Ozer O. Anxiety score as a risk factor for radial artery vasospasm during radial interventions: a pilot study. <i>Angiology.</i> 2014 Jan;65(1):67-70. doi: 10.1177/0003319713488931. Epub 2013 May 8. PMID: 23657175.
InformedHealth.org [Internet]. Cologne, Germany: Institute for Quality and Efficiency in Health Care (IQWiG); 2006-. How does the blood circulatory system work? 2010 Mar 12 [Updated 2019 Jan 31]. Available from: https://www.ncbi.nlm.nih.gov/books/NBK279250/
Jackson T, Hallam C, Corner T, Hill S. Right line, right patient, right time: every choice matters. <i>Br J Nurs.</i> 2013 Apr 25-May 8;22(8):S24, S26-8. doi: 10.12968/bjon.2013.22.Sup5.S24. PMID: 23752501.
Lamperti M, Pittiruti M. II. Difficult peripheral veins: turn on the lights. <i>Br J Anaesth.</i> 2013 Jun;110(6):888-91.
<i>Miller v. Hamm</i> , No. 2:22-cv-00506, Doc. No. 79-1 (Oct. 6, 2022)
R. E. Helm, J. D. Klausner, J. D. Klemperer, L. M. Flint, and E. Huang, "Accepted but unacceptable," <i>Journal of Infusion Nursing</i> , vol. 38, no. 3, pp. 189–203, 2015.
Rapp SE, Pavlin DJ, Nessly ML, Keyes H. Effect of Patient Position on the Incidence of Vasovagal Response to Venous Cannulation. <i>Arch Intern Med.</i> 1993;153(14):1698–1704. doi:10.1001/archinte.1993.00410140084010
Rothschild JM. Ultrasound guidance of central vein catheterization. In: <i>On Making Health Care Safer: A Critical Analysis of Patient Safety Practices</i> . Rockville, MD: AHRQ Publications; 2001; Chapter 21: 245–255. Available at: http://www.ahrq.gov/clinic/ptsafety/chap21.htm . Accessed February, 2008.
Ruesch S, Walder B, Tramèr MR. Complications of central venous catheters: internal jugular versus subclavian access--a systematic review. <i>Crit Care Med.</i> 2002 Feb;30(2):454-60. doi: 10.1097/0003246-200202000-00031. PMID: 11889329.
<i>Smith v. Hamm</i> , No. 2:22-cv-00497, Doc. No. 1 (Aug, 18, 2022)
Zingg W, Pittet D. Peripheral venous catheters: an under-evaluated problem. <i>Int J Antimicrob Agents.</i> 2009;34 Suppl 4:S38-42. doi: 10.1016/S0924-8579(09)70565-5. PMID: 19931816.

Exhibit B: CV**The Faculty of Medicine of Harvard University
Curriculum Vitae**

Date June 28, 2022
Prepared:
Name: Robert Jason Yong
Office Brigham and Women's Hospital
Address: Department of Anesthesiology, Perioperative and Pain Medicine
75 Francis Street
Boston, MA 02115
Home Address: [REDACTED]
Work Phone: 617-983-7080
Work Email: ryong@bwh.harvard.edu
Place of Birth: Kuching, Sarawak; Malaysia

Education:

1998-2002	BA	Biology	University of Texas, Austin, TX
2002-2007	MD	Medicine	Baylor College of Medicine, Houston, TX
2004-2006	MBA	Business Administration	Rice University, Jones Graduate School of Management, Houston, TX

Postdoctoral Training:

2007-2008	Intern	General Surgery	Beth Israel Deaconess Medical Center
2008-2011	Resident	Anesthesiology	Brigham and Women's Hospital
2010-2011	Chief Resident	Department of Anesthesia	Brigham and Women's Hospital
2011-2012	Fellow	Pain Management	Brigham and Women's Hospital

Faculty Academic Appointments:

2012-2013	Assistant Professor	Anesthesia	Johns Hopkins Medical School, Baltimore, MD
2013-2019	Instructor	Anaesthesia	Harvard Medical School, Boston, MA
2019-	Assistant Professor	Anaesthesia	Harvard Medical School, Boston, MA

Appointments at Hospitals/Affiliated Institutions:

2012-2013	Attending	Anesthesia	Johns Hopkins Hospital
2013-	Attending	Anesthesia	Brigham & Women's Hospital

Other Professional Positions:

2016-	Consultant	Medtronic	2 days per year
2016-2020	Scientific Advisory Board	axialHealthcare	12 days per year
2017-	Consultant	Nevro	2 days per year
2019-	Consultant	Endo Pharmaceuticals	12 days per year
2019-	Consultant	Abbott	2 days per year

Major Administrative Leadership Positions:**Local**

2013-	Founding Co-Director, Spine Center	Brigham and Women's Faulkner Hospital
2013-2017	Founding Medical Director of Pain Management	Brigham and Women's Faulkner Hospital
2014-	Co-founder and Facilitator: Fellow Lecture Series	Brigham and Women's Faulkner
2014-2021	Associate Program Director of Pain Management	Brigham and Women's Hospital
2017-	Medical Director of Pain Management Center	Brigham and Women's Hospital
2020-2021	Associate Chief of Pain Medicine Division	Brigham and Women's Hospital
2021-	Chief of Pain Medicine Division	Brigham and Women's Hospital

Committee Service:**Local**

2010-2011	Residency Admissions Interview Committee	Department Anesthesiology, Brigham and Women's Hospital
2012-2013	Residency Admissions Interview Committee	Department Anesthesiology, Johns Hopkins Hospital
2013-	Fellowship Admissions Interview Committee	Brigham and Women's Hospital
2013-2015	Medical Executive Committee	Brigham and Women's Faulkner
2014-	Ambulatory Advisory Council	Brigham and Women's Faulkner
2014-	Pain Fellowship Clinical Competency Committee	Brigham and Women's Hospital
2014-	Program Evaluation Committee	Brigham and Women's Hospital
2015-2018	Opioid Management Subcommittee	Brigham and Women's Faulkner
2015-2019	Opiate Ad Hoc Committee	Harvard Medical School
2016-	B CORE Standards Committee	Brigham and Women's Faulkner
2016-2020	Office for Multicultural Careers Advisory Committee	Brigham and Women's Hospital
2017-	Residency Admissions Committee	Brigham and Women's Hospital
2017-	Residency Clinical Competency Committee	Brigham and Women's Hospital
2019-	Faculty Board, Department of Anesthesiology	Brigham and Women's Hospital

National

2014-	Program Director Committee, Representing BWH Pain Medicine Fellowship	American Board of Anesthesiology
2016-	MOCA Minute: Pain Medicine Subcommittee	American Board of Anesthesiology
2022-2022	Program and Evaluation Committee, Summer 2022 Meeting	Eastern Pain Association

Professional Societies:

2007-	American Society of Anesthesiologists
2007-	Massachusetts Medical Association
2007-	Massachusetts Society of Anesthesiologists
2007-2012	American Medical Association
2011-2019	American Pain Society
2014-	American Society of Interventional Pain Physicians

2014-	American Academy of Pain Medicine
2014-2016	International Spine Intervention Society
2016-	North American Neuromodulation Society
2016	American Society of Regional Anesthesia

Editorial Activities:**Ad hoc Reviewer**

Headache Journal
The Journal of Delivery Science and Innovation
Pain Practice
Spine Journal

Other Editorial Roles

2017	Editor in Chief	Pain Medicine: An Essential Review, 1st Ed. Springer International
2020	Editor	Interventional Management of Chronic Visceral Pain Syndromes, 1st Ed. Elsevier, 2020

Honors and Prizes:

1998	Texas Valedictorian Scholarship, Texas	University of Texas, Austin, TX
2002	Baylor College of Medicine Community Service Scholarship	Baylor College of Medicine, Houston, Texas
2005	Rice University's Jones Graduate School of Management Academic Scholarship	Rice University, Jones Graduate School of Management,, Houston, TX
2011	Distinguished Resident of the Year	Anesthesia Department, Brigham & Women's Hospital, Boston, MA
2011	Foundation for Anesthesia Education and Research (FAER) Practice Management	Resident Scholar Program, Pittsburgh, Pennsylvania
2011	Grant Finalist, Center for Integration of	CIMIT, Boston, MA

	Medicine and Innovative Technology (CIMIT) Research	
2011	National Collegiate Inventors and Innovators Alliance Award for participation in the Ventures Lab	Venture Lab, Cambridge, MA
2011	Young Innovator Award	Harvard School of Engineering & Applied Science, Boston, MA
2013	Distinguished Intraoperative Teaching and Clinical Mentorship	Department of Anesthesiology, Johns Hopkins Hospital, Baltimore, MD
2013	Outstanding Teacher of the Year	Department of Anesthesiology, Johns Hopkins Hospital, Baltimore, MD
2014, 2015, 2016, 2020, 2021	Pain Attending of the Year Award	Department of Anesthesiology, Brigham and Women's Hospital, Boston, MA
2014, 2018	Partners in Excellence Award for Leadership and Innovation	Brigham and Women's Hospital, Boston, MA
2018	Outstanding Mentoring Award	Department of Anesthesiology, Brigham and Women's Hospital, Boston, MA
2018	Pain Attending of the Year Award,	Department of Anesthesiology, Brigham and Women's Hospital, Boston, MA

Report of Funded and Unfunded Projects

Past

2015-2019 Prediction of Persistent Post-Mastectomy Pain	Prediction of Persistent Post-Mastectomy Pain NIH (NIGMS); K23 GM110540 Co-Investigator (PI: K. Schreiber) This project investigates the ability of preoperatively assessed variables
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	including psychosocial evaluation and QST to predict risk of chronic pain after surgery, and allow development of a study enrichment tool to investigate existing and novel perioperative preventive therapies
2016-2018	<p>ReActiv8-B trial</p> <p>Mainstay Medical Limited</p> <p>Co-Investigator (PI: Christopher Gilligan)</p> <p>An international, multi-center, prospective randomized sham-controlled IDE trial at up to 40 clinical trial sites and for 128 randomized subjects to be implanted with an innovative implantable neurostimulation system (Reactiv8). Device is intended to reduce the pain and disability of Chronic Lower Back Pain (CLBP) by helping to restore control to the muscles that dynamically stabilize the lumbar spine</p>
2017-2020	<p>Prevention of Post-Mastectomy Pain with perioperative ketamine administration: A randomized, controlled trial.</p> <p>NIH (NIGMS); K23 GM110540</p> <p>Site - PI (PI: K. Schreiber)</p> <p>This project investigates the role of ketamine in the prevention or modulation of post mastectomy pain syndrome following mastectomy.</p>
2018-2019	<p>Algovita Post-Market Clinical Study: Spinal Cord Stimulation to Treat Chronic Pain</p> <p>Nuvecra Medical</p> <p>PI</p> <p>Multi-center, prospective post market study following patients implanted with Nuvecra's Algovita spinal cord stimulator (\$1800 per patient with 10 estimated patients)</p>
2018-2019	<p>Algovita Ultra High Pulse Width Clinical Study: Spinal Cord Stimulation to Treat Chronic Pain</p> <p>Nuvecra Medical</p> <p>PI</p> <p>Multi-center, prospective study following patients implanted with Nuvecra's Algovita spinal cord stimulator utilizing ultra high pulse width settings (\$1800 per patient with 10 estimated patients).</p>
2018-2019	<p>Pilot Study to Examine the Feasibility of the DISCSS (Dynamic Interferential Spinal Cord Stimulation System)</p> <p>Meagan Medical Inc</p> <p>PI</p> <p>Multi-center, prospective pilot study following patients using a spinal cord stimulator trial with a novel dynamic interferential system and measuring outcomes compared to traditional stimulation (\$4490 per patient with 10 estimated patients).</p>
2019-2020	<p>Clonidine Micropellet Clinical Study for Radiculopathy</p> <p>Sollis Therapeutics, Inc.</p> <p>PI</p> <p>Prospective, multi-center, randomized, double-blinded, sham-controlled study to evaluate the efficacy and safety of clonidine micropellets for the</p>

	treatment of pain associated with lumbosacral radiculopathy in adults (\$9,633 per patient with 20 estimated patients).
2019-2022	<p>PROLONG Neuromodulation Study for Post Laminectomy Syndrome Abbott PI</p> <p>prospective, multi-center, open-label, post-market study following patients who have failed stimulation previously and are now using BurstDR waveforms or Dorsal Root Ganglion stimulation with restored efficacy (\$ per patient with 10 estimated patients).</p>
2021	<p>RELIEF Boston Scientific PI (\$25,941)</p> <p>The primary objective of this study is to compile characteristics of real-world clinical outcomes for Boston Scientific commercially approved neurostimulation systems for pain in routine clinical practice, when used according to the applicable Directions for Use. The secondary objective of this study is to evaluate the economic value and technical performance of Boston Scientific commercially approved neurostimulation systems for pain in routine clinical practice</p>
Current	
2020-	<p>A Phase 3, Randomized, Double Blinded, Active Controlled, Multicenter Study to Evaluate the Efficacy, Safety and Pharmacokinetics of EXPAREL admixed with Bupivacaine vs Bupivacaine only administered as Combined Sciatic (in popliteal fossa) and Adductor Canal Nerve Block for Postsurgical Analgesia in Subjects Undergoing Lower Extremity Surgeries Co-Investigator (PI: Srdjan Nedeljkovic) This study will evaluate the efficacy of liposomal bupivacaine when given as a Sciatic (in popliteal fossa) and Adductor Canal nerve block following foot and ankle surgery compared to plain bupivacaine</p>
2020-	<p>SCOPE Superion Study for Neurogenic Claudication Boston Scientific PI (\$40,159.00) Multi-center, prospective, observational, single-arm, post-approval study to evaluate the Superion interspinous process spacer outcomes in patients with lumbar spinal stenosis resulting in neurogenic claudication</p>
2020-	<p>SKOAP Sequenced strategy for improving outcomes in people with knee osteoarthritis pain Co-Investigator (PI: Robert Edwards) There is an urgent public health need to reduce our reliance on opioids for effective long-term pain management, particularly in knee osteoarthritis (KOA). This effectiveness trial will compare recommended treatments to reduce pain and functional limitations in KOA and identify clinical and patient-level factors associated with treatment response.</p>

These results will lead to improved patient selection for treatment and inform evidence-based guidelines by offering well-tested, effective, non-opioid alternatives.

Unfunded Current Projects

2019- IRB pending Case Series Evaluating the Compliance and Efficacy of Smart Pill-bottles
PI
Single-center, prospective cohort evaluating patient compliance of Bluetooth enabled smart pill dispensers for opioid medication and efficacy of reducing opioid misuse and abuse

2020- IRB pending Utilizing a Cadaver-Training Simulator to Teach Interventional Spine Procedures
PI
Single-center, analyzing an innovative approach to educating fellows and residents on interventional spine procedures measuring accuracy, comfort, radiation exposure, and time

Report of Local Teaching and Training

Teaching of Students in Courses:

2011	BUS 2107 Commercializing Science Class Clinical advisor to graduate students	Harvard Business School, Cambridge, MA 1 hour / year
2011	ES227 Medical Device Design Class graduate students	Harvard Graduate School of Engineering, Cambridge, MA 1 hour / year
2011	Introduction to Anesthesia: What does a career in anesthesia look like? medical students	Harvard Medical School 1 hour / week

Formal Teaching of Residents, Clinical Fellows and Research Fellows (post-docs):

2010	Interpretation of an Arterial Blood Gas Critical Care residents, fellows and staff	SICU Lecture Series, BWH Dept. Anesthesia, Perioperative and Pain Medicine 1 hour / year
2010	Malignant Hyperthermia. Residents/fellows	Sunrise Lecture Series, BWH Dept. Anesthesia, Perioperative and Pain Medicine 1 hour / year
2011	Hypertension in Pregnancy, OB anesthesia residents	OB Lecture Series, BWH Dept. Anesthesia, Perioperative and Pain

		Medicine 1 hour / week
2011-2012	High Yield Board Topics Anesthesia residents	Sunrise Lecture Series, BWH Dept. Anesthesia, Perioperative and Pain Medicine 1 hour / year 30 minute lecture annually
2012	Complex Regional Pain Syndrome Anesthesia residents, fellows	Sunrise Lecture Series, BWH Dept. Anesthesia, Perioperative and Pain Medicine 1 hour / week
2012	Complications of Back Surgery Anesthesia fellows	Fellow's Curriculum Series, BWH Dept. Anesthesia, Perioperative and Pain Medicine 1 hour / week
2012	Methadone Anesthesia residents, fellows	Sunrise Lecture Series, BWH Dept. Anesthesia, Perioperative and Pain Medicine 1 hour / week
2012-2013	Acute Pain Management medical students	College Day Lecture Series, Johns Hopkins Hospital, Dept of Anesthesia and Perioperative Medicine 1 hour / year
2012-2013	Cancer Pain medical students	College Day Lecture Series, Johns Hopkins Hospital, Dept of Anesthesia and Perioperative Medicine 1 hour / year
2013-	Advanced Pain Medicine Department CA-2/3 Residents	BWH Dept. Anesthesia, Perioperative and Pain Medicine 3 hours / year
2013-	Basics of Pain Medicine Department CA-1 Residents	Residency Didactic Lecture Series, BWH Dept. Anesthesia, Perioperative and Pain Medicine 3 hours / year
2013-	Cancer Pain Medicine Department CA-2/3 Residents (Residency Didactic Lecture Series, BWH Dept. Anesthesia, Perioperative and Pain Medicine 3 hours / year
2013	Minimally Invasive Lumbar Decompression, residents, fellows	Pain Management Lecture Series, BWH Dept. Anesthesia, Perioperative and Pain Medicine 1 hour / week

2015-	Interventional Pain Management Coding and Billing, residents, fellows	Faulkner Pain Management Center Lecture Series, Brigham and Women's Faulkner Hospital, Department of Anesthesia 1 hour / year
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Clinical Supervisory and Training Responsibilities:

2012-2013	Supervision Residents and CRNA's	Johns Hopkins Hospital, Department of Anesthesiology 8 hours / week
2013-	Supervision Residents, Fellows, Nurse Practitioners, and Physician Assistants	BWH APPM, Division of Pain Medicine 6 hours / week
2013-	Supervision Residents and CRNA's	BWH APPM, Department of Anesthesiology 2 hours / week

Other Mentored Trainees and Faculty:

2012-2013	Liang Shen, MD / Instructor, Weill Cornell Medical College Career stage: Resident. Mentoring role: Clinical guidance and performance evaluation. Accomplishments: multiple first authored scholarship; Fellowship in Critical Care
2013-2014	Ehren Nelson, MD / Instructor, Brigham and Women's Hospital Career stage: Resident and Fellow. Mentoring role: Clinical guidance, performance evaluation, and academic mentoring. Accomplishments: Multiple national and international invited lectures; Fellowship in Pain Medicine
2014-2015	Isaac Tong, MD / Pain Medicine Attending, San Antonio Career stage: Resident and fellow, Brigham and Women's Hospital. Mentoring role: Faculty mentor during Residency and Pain Fellowship with guidance and performance evaluation Established a strong reputation as a key opinion leader and expert in pain medicine and practice development.
2014-2017	Jessica Hellums, MD / Pain Medicine Fellow, Brigham and Women's Hospital Career stage: Resident. Mentoring role: Faculty mentor during CA-1/2/3 year with guidance and performance evaluation Established a strong reputation as a key opinion leader and expert in pain medicine and practice development.

2015-2016	Mona Patel, MD / Pain Medicine Attending, Irvine, California Career stage: Fellow, Brigham and Women's Hospital. Mentoring role: Faculty mentor during Pain Fellowship with guidance and performance evaluation Established a strong reputation as a key opinion leader and expert in pain medicine and academic publications.
2015-2016	Jeffrey McLaren, MD / Pain Medicine Fellow, Virginia Mason Career stage: Resident, Brigham and Women's Hospital. Mentoring Role: Faculty mentor during CA-3 year with guidance and performance evaluation Established a strong reputation as a key opinion leader and expert in pain medicine.
2015-2018	Brandon Napstad, MD / Anesthesiology Resident, Brigham and Women's Hospital Career stage: Resident. Mentoring role: Faculty mentor during CA-1-3 year with guidance and performance evaluation Established a strong reputation as a clinical anesthesiologist.
2016-2017	Victor Wang, MD / Instructor, Brigham and Women's Hospital Career stage: Fellow. Mentoring role: Faculty mentor during Pain Fellowship with guidance and performance evaluation. Accomplishments: Multiple first authored scholarship
2016-2019	David Buric, MD / Anesthesiology Resident, Brigham and Women's Hospital Career stage: Resident. Mentoring role: Faculty mentor during CA-1-3 year with guidance and performance evaluation Completed cardiac and ICU fellowships with significant academic productivity.
2016-2019	Andrew Pisansky, MD / Anesthesiology Resident, Brigham and Women's Hospital Career stage: Resident. Mentoring role: Faculty mentor during CA-1-3 year with guidance and performance evaluation Completed a pain fellowship and is now director of acute pain at Vanderbilt with significant academic productivity.
2017-2018	Fang Fang Xing, MD / Pain Management Fellow, Brigham and Women's Hospital Career stage: Fellow. Mentoring role: Faculty mentor during Pain Fellowship with guidance and evaluation. Accomplishments: multiple first authored scholarship

2017-2020	<p>Shafiq Boyaji, MD / Anesthesiology Resident, Brigham and Women's Hospital</p> <p>Career stage: Resident.</p> <p>Mentoring role: Faculty mentor during CA-1-3 year with guidance and performance evaluation</p> <p>Established a strong reputation as a key opinion leader and expert in pain medicine and practice development with academic productivity.</p>
2018-2019	<p>Michael Lubrano, MD / Pain Management Fellow, Brigham and Women's Hospital</p> <p>Career Stage: Fellow.</p> <p>Mentoring role: Faculty mentor during Pain Fellowship with guidance and evaluation.</p> <p>Accomplishments: multiple first authored scholarship</p>
2019-2020	<p>Bilal Dar, MD / Pain Management Fellow, Brigham and Women's Hospital.</p> <p>Career Stage: Fellow</p> <p>Mentoring role: Faculty mentor during Pain Fellowship with guidance and evaluation.</p> <p>Accomplishments: case reports</p>
2019-2022	<p>Kunal Mandavawala, MD – Anesthesiology Resident, Brigham and Women's Hospital.</p> <p>Career Stage: Resident.</p> <p>Mentoring role: Faculty mentor during CA 1-3 year with guidance and performance evaluation</p> <p>Will be completing cardiac and ICU fellowships with significant academic productivity.</p>
2020-2023	<p>Michael Fiore, MD, pharmD – Anesthesiology Resident, Brigham and Women's Hospital.</p> <p>Career Stage: Resident.</p> <p>Mentoring role: Faculty mentor during CA 1-3 year with guidance and performance evaluation</p> <p>Will be applying for pain with significant research involving medical education.</p>

Formal Teaching of Peers (e.g., CME and other continuing education courses):

No presentations below were sponsored by 3rd parties/outside entities

2015	Chronic Venous Insufficiency, Comprehensive Review of Pain Medicine, [Directed by Dr. Edgar Ross. Recorded CME video lecture]	single presentation Boston
	sponsored by Oakstone	

Local Invited Presentations:

No presentations below were sponsored by 3rd parties/outside entities

2014	Pain Treatment Modalities and Palliative Care for Cognitively Impaired and Terminally Ill Patients / Invited Lecture 2nd Annual Pain Management Lecture, Brigham and Women's Hospital
2014	Spine Views for Interventional Pain Procedures / Invited Lecture Massachusetts Society of Radiologic Technologists, Brigham and Women's Hospital
2018	Post-operative Pain and the Chronic Pain Patient / Invited Lecture PACU Lecture Series. Brigham and Women's Faulkner Hospital

Report of Regional, National and International Invited Teaching and Presentations

No presentations below were sponsored by 3rd parties/outside entities

Regional

2015	Advances in Chronic Pain Management / Grand Rounds Tufts University, Anesthesiology, Boston, MA
2021	Opioid Management / Invited Speaker New Hampshire Medical Society, Conway, NH

National

2013	Perioperative Pain Management, Optimal Anesthesia Management / Invited Lecture Johns Hopkins Anesthesia Continuing Education, Baltimore, MD
2013	Pharmacology of Anesthetics / Invited Lecture Johns Hopkins Regional Live Meeting Series, Boston
2013	Preoperative Patient Assessment / Invited Lecture Johns Hopkins Regional Live Meeting Series, Boston
2015	Cutting Edge Chronic Pain / Grand Rounds George Washington University, Anesthesiology, Washington, DC
2016	Innovation: Treatment and Prescribing Panelist and Moderator, Tennessee Pain Opioids Problems Solutions Forum / Symposium Nashville, TN
2017	Current Topics in Pain Medicine / Grand Rounds Kaiser Permanente, Department of Anesthesiology, San Diego, CA
2017	Novel Therapies in Pain Medicine / Grand Rounds Medical University of South Carolina, Department of Anesthesiology, Charleston, SC
2018	On and Off Label Applications for Pain Control / Invited Lecture NYC Neuromodulation Conference and NANS Summer Series, New York, NY

2019	Interpretation of Spinal Diagnostic Imaging Studies: Learning a Structured Approach / Invited Speaker American Society of Anesthesiology, Orlando, FL
2020	Lumbar Spinal Stenosis Novel Therapies / Invited Speaker Multi-institution COVID-19 Lecture Series, Sponsored by University of Washington
2020	Peripheral Nerve Stimulation / Invited Speaker American Society of Neuro Radiologists, Las Vegas, NV
2020	Waveform Innovation in Spinal Cord Stimulation / Invited Speaker Multi-institution COVID-19 Lecture Series, Sponsored by University of Washington
2021	Pain Medicine: Practice Management and Billing Compliance University of Miami
2022	Pain Management and Opioid Stewardship OhioHealth
2022	Spinal Cord Stimulation: New Devices and Advances / Invited Lecture Brown University, Medical School, Department of Anesthesiology
2022-2022	Keynote: CDC Opioid Prescribing Guidelines Update – Thoughts, Impacts & Where do we go from here / Keynote Lecture Eastern Pain Association Annual Meeting
2022-2022	Pathophysiology of Pain - A 2022 Update / Invited Lecture Harvard Medical School, Evaluating & Treating Pain Conference Lecture and Panel

International

2017	Difficult Airway Management / Anesthesiology Grand Rounds Kanombe Military Hospital, Kigali, Rwanda
2017	Nerve Blocks for Facial Surgery / Anesthesiology Grand Rounds Santa Casa Hospital, Sao Paulo, Brazil
2019	Perioperative Pain Management and Alternatives to Opioids / Invited Speaker Korean American Spine Society Annual Meeting, Vancouver, CA
2019	State of the Art in Interventional Pain Procedures / Invited Speaker Korean American Spine Society Annual Meeting, Vancouver, CA

Report of Clinical Activities and Innovations**Current Licensure and Certification:**

2005-	American Heart Association, Basic and Advanced Cardiac Life Support
2008-	Permanent Licensee, State of Massachusetts
2012-	Diplomate, American Board of Anesthesiology
2012-	Diplomate, American Board of Anesthesiology Pain Medicine
2012-2014	Permanent Licensee, State of Maryland

Practice Activities:

2012-2013	General and regional anesthesia	Johns Hopkins Hospital, Baltimore, MD	40 hours / week
2013-	General and regional anesthesia	Brigham and Women's Hospital, Boston, MA	10 hours / week
2013	Pain Medicine Physician	Brigham and Women's Hospital, Boston, MA	30 hours / week

Clinical Innovations:

Cofounder of multidisciplinary spine center / BWF (2014)	As founding medical director of Brigham and Women's Faulkner Hospital's Pain Management Center, a high priority was increased collaboration with the other services in the hospital. After our initial collaboration with the Graham Headache Center proved to be successful, we decided to build a spine center with operative and non-operative services focused on comprehensive spine care. We used a wing of the newly built Orthopedic center at Faulkner to carve out 6 exam rooms and a multi-use work area to build a center where Orthopedics or Neurosurgery was collocated with Psychiatry or Pain Medicine. Serving on the governance committee since the inception, I have actively been involved with the creation of workflows, marketing, and management of the spine center. Over the previous 4 years, we have grown the spine center tremendously while solidifying collaboration between all services.
Implemented changes for practice efficiency / BWH Pain Ctr (2017)	Because of the significant clinical and financial growth of the Brigham and Women's Faulkner Hospitals Pain Management Center, I was selected to be the Medical Director of Brigham and Women's main Pain Management Center. In this position, I created several processes and work flow changes to improve efficiency. First, I changed the schedule to split out procedures and evaluations into separate sessions. Doing this provided each attending physician dedicated geography and resources to see more patients in less time while reducing wasted footsteps. Next, I worked with Epic to create several shortcuts and orders so providers could quickly enter an order for a procedure which would then automatically enter the work queue for managed care services to obtain prior authorization. The new orders have helped to minimize denials while ensuring the proper time and location are allocated for the desired procedure. I also helped create the new order system providers use to refer patients to our multiple locations of Pain Medicine.
Creator of new reporting for Pain Management Center / BWH pain Ctr	Also in my role as Medical Director of Brigham and Women's Pain Management Center, I created two new reports the administration and staff use monthly. The first report is a gaps analysis to determine sessions where we have inadequate provider coverage. The second report is a productivity report that marries our billing database with the scheduling system to provide the physicians aggregate productivity data

(2017)

Introduction of
Radiofrequency
Identification to
measure time
driven activity
based costing /
(2018)

that can then be drilled down into individual days. The report is now used by attending physicians to track their productivity and by the finance division to cross verify their reporting measures.

In collaboration with MIT and Harvard Business School I am coordinating the implementation of radiofrequency identification (RFID) tags and readers to more accurately and robustly calculate costs of a given activity using time driven activity based costing (TDABC). The current models utilizing TDABC in healthcare rely on manual recordings of each step in an activity. Utilizing RFID would minimize the measurement bias and allow for a larger sample size.

Report of Teaching and Education Innovations

Co-founder for the
Faulkner Lecture
Series
(2014)

I co-created a lecture series for the Pain Medicine fellows. In the lecture series, we invite lecturers from other specialties including orthopedics, radiology, psychiatry, and law to discuss practical concepts in Pain Management to prepare them for their early careers. The feedback from the fellows is superb and an integral part of their education.

Creator and
manager of
Faulkner Hospital
Pain rotation
(2016)

Since founding the Brigham and Women's Faulkner Hospital's Pain Management Center in 2013, we have been asked to host rotation for interns, residents, and fellows. Each year we have a growing number of residents requesting the rotation for the CA-3's pain medicine elective – even for residents not specializing in Pain Medicine. Additionally, we now host Neurology Headache fellows, Regional Anesthesia fellows, and categorical anesthesia interns. I coordinate and evaluate all rotating trainees through the Pain Center.

Introduction of
pain simulation
(2018-)

Simulation in anesthesiology is now a standard for resident education, however, within Pain Medicine simulation has not gained traction. I worked with a company called Biotras to bring a spine simulator with cadaveric bone and ballistic gel to the Pain Management Center at Brigham and Women's Hospital. We organized two sessions for the 2018-2019 fellow class to practice obtaining the correct views and directing the needle for four of our most common procedures. The feedback was so overwhelmingly positive from the fellows that we are adding teaching modules on the spine simulator to the 2019-2020 Pain Medicine fellowship curriculum.

Report of Education of Patients and Service to the Community

No presentations below were sponsored by 3rd parties/outside entities

Activities

1999

Medical Mission
Medical mission to Guatemala with Sending Out Servants

2000-2002	Big Brothers Big Sisters Over 500 hours spent as a mentor in Austin, TX
2000-2002	Habitat for Humanity Habitat for Humanity via Texas Blazers
2010	Global Smile Foundation Medical Mission to Cote D'Ivoire, Global Smile Foundation (Anesthesiologist)
2011	Global Smile Foundation Medical Mission, Ecuador with the Global Smile Foundation (Anesthesiologist)
2012, 2015	Global Smile Foundation Medical Mission, Guatemala with the Global Smile Foundation (Anesthesiologist)
2017	Face the Future Foundation Medical Mission, Rwanda with Face the Future (Anesthesiologist)
2017	Global Smile Foundation Medical Mission, Brazil with Global Smile Foundation (Anesthesiologist)
2018, 2019	Face the Future Foundation Medical Mission, Rwanda with Face the Future Foundation (Anesthesiologist)

Educational Material for Patients and the Lay Community:

Patient educational material

2015	Managing with Low Back	BWF, Community Lecture Series
2016	Novel Techniques for Treating Low Back Pain	BWF, Community Lecture Series

Recognition:

2010	Featured in Brigham and Women's Hospital Bulletin	12/13/2010 article: Driving Clinical Innovations at BWH
2011	Featured in the Harvard Gazette (September 20, 2011) Surgical Precision at SEAS	9/20/2011 article: Innovation and Medical Device Design
2016	Featured in Tennessean (April 5, 2016)	4/5/2016 article: Health care leaders urge action on opioid abuse
2016	Highlighted in educational marketing video for Brigham and Women's Hospital	5/6/2016 video: Managing Back Pain

2016	Highlighted in marketing video for Faulkner Hospital Pain Management Center	5/12/2016 video: Pain Management Center at BWFH
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Report of Scholarship

ORCID: 0000-0001-6960-9621

* Co-author, ** Mentee

Peer-Reviewed Scholarship in print or other media:

Research Investigations

1. Brattain LJ, Floryan C, Hauser OP, Nguyen M, **Yong RJ**, Kesner SB, Corn SB, Walsh CJ. Simple and effective ultrasound needle guidance system. *Annu Int Conf IEEE Eng Med Biol Soc.* 2011;2011:8090-8093. PMID: 22256219, <https://doi.org/10.1109/IEMBS.2011.6091995>
2. **Yong RJ**, Nelson ER, Urman RD, Kaye AD. A primer for billing in interventional pain management. *J Med Pract Manage.* 2015 Mar-Apr;30(6 Spec No):51-54. PMID: 26062319
3. Imran TF, Malapero R, Qavi AH, Hasan Z, de la Torre B, Patel YR, **Yong RJ**, Djousse L, Gaziano JM, Gerhard-Herman MD. Efficacy of spinal cord stimulation as an adjunct therapy for chronic refractory angina pectoris. *Int J Cardiol.* 2017 Jan 15;227:535-542. PMID: 27836302, [https://doi.org/S0167-5273\(16\)33323-X](https://doi.org/S0167-5273(16)33323-X)
4. Kim AJ, **Yong RJ**, Urman RD. The Role of Transversus Abdominis Plane Blocks in Enhanced Recovery After Surgery Pathways for Open and Laparoscopic Colorectal Surgery. *J Laparoendosc Adv Surg Tech A.* 2017 Sep;27(9):909-914. PMID: 28742435, <https://doi.org/10.1089/lap.2017.0337>
5. Pak DJ, **Yong RJ**, Kaye AD, Urman RD. Chronification of Pain: Mechanisms, Current Understanding, and Clinical Implications. *Curr Pain Headache Rep.* 2018 Feb 5;22(2):9. PMID: 29404791, <https://doi.org/10.1007/s11916-018-0666-8>
6. Xing F, **Yong RJ**, Kaye AD, Urman RD. Intrathecal Drug Delivery and Spinal Cord Stimulation for the Treatment of Cancer Pain. *Curr Pain Headache Rep.* 2018 Feb 5;22(2):11. PMID: 29404792, <https://doi.org/10.1007/s11916-018-0662-z>
7. Simopoulos T, **Yong RJ**, Gill JS. Treatment of Chronic Refractory Neuropathic Pelvic Pain with High-Frequency 10-kilohertz Spinal Cord Stimulation. *Pain Pract.* 2018 Jul;18(6):805-809. PMID: 29106051, <https://doi.org/10.1111/papr.12656>
8. Wang VC, Preston MA, Kibel AS, Xu X, Gosnell J, **Yong RJ**, Urman RD. A Prospective, Randomized, Double-Blind, Placebo-Controlled Trial to Evaluate Intravenous Acetaminophen Versus Placebo in Patients Undergoing Robotic-Assisted Laparoscopic Prostatectomy. *J Pain Palliat Care Pharmacother.* 2019 Jan 15;32(2-3):82-89. PMID: 30645153, <https://doi.org/10.1080/15360288.2018.1513436>

9. Atkinson TJ, Pisansky AJB, Miller KL, **Yong RJ**. Common elements in opioid use disorder guidelines for buprenorphine prescribing. *Am J Manag Care*. 2019 Mar 1;25(3):e88-e97. PMID: 30875177
10. Morales A, **Yong RJ**, Kaye AD, Urman RD. Spinal Cord Stimulation: Comparing Traditional Low-frequency Tonic Waveforms to Novel High Frequency and Burst Stimulation for the Treatment of Chronic Low Back Pain. *Curr Pain Headache Rep*. 2019 Mar 14;23(4):25. PMID: 30868285, <https://doi.org/10.1007/s11916-019-0763-3>
11. Valimahomed AK, Haffey PR, Urman RD, Kaye AD, **Yong RJ**. Regenerative Techniques for Neuraxial Back Pain: a Systematic Review. *Curr Pain Headache Rep*. 2019 Mar 11;23(3):20. PMID: 30854599, <https://doi.org/10.1007/s11916-019-0758-0>
12. Boyaji S, Merkow J, Elman RNM, Kaye AD, **Yong RJ**, Urman RD. The Role of Cannabidiol (CBD) in Chronic Pain Management: An Assessment of Current Evidence. *Curr Pain Headache Rep*. 2020 Jan 24;24(2):4. PMID: 31980957, <https://doi.org/10.1007/s11916-020-0835-4>
13. Coppes OJM, **Yong RJ**, Kaye AD, Urman RD. Patient and Surgery-Related Predictors of Acute Postoperative Pain. *Curr Pain Headache Rep*. 2020 Feb 18;24(4):12. PMID: 32072315, <https://doi.org/10.1007/s11916-020-0844-3>
14. Costelloe C, Burns S, **Yong RJ**, Kaye AD, Urman RD. An Analysis of Predictors of Persistent Postoperative Pain in Spine Surgery. *Curr Pain Headache Rep*. 2020 Feb 18;24(4):11. PMID: 32072357, <https://doi.org/10.1007/s11916-020-0842-5>
15. Merkow J, Varhabhatla N, Manchikanti L, Kaye AD, Urman RD, **Yong RJ**. Minimally Invasive Lumbar Decompression and Interspinous Process Device for the Management of Symptomatic Lumbar Spinal Stenosis: a Literature Review. *Curr Pain Headache Rep*. 2020 Feb 18;24(4):13. PMID: 32072362, <https://doi.org/10.1007/s11916-020-0845-2>
16. Blevins Peratikos M, Weeks HL, Pisansky AJB, **Yong RJ**, Stringer EA. Effect of Preoperative Opioid Use on Adverse Outcomes, Medical Spending, and Persistent Opioid Use Following Elective Total Joint Arthroplasty in the United States: A Large Retrospective Cohort Study of Administrative Claims Data. *Pain Med*. 2020 Mar 1;21(3):521-531. PMID: 31120529, PMCID: PMC7060398, <https://doi.org/10.1093/pmt/pnz083>
17. Li L, **Yong RJ**, Kaye AD, Urman RD. Perioperative Point of Care Ultrasound (POCUS) for Anesthesiologists: an Overview. *Curr Pain Headache Rep*. 2020 Mar 21;24(5):20. PMID: 32200432, <https://doi.org/10.1007/s11916-020-0847-0>
18. Morales ME, **Yong RJ**. Racial and Ethnic Disparities in the Treatment of Chronic Pain. *Pain Med*. 2021 Feb 4;22(1):75-90. PMID: 33367911, <https://doi.org/10.1093/pmt/pnaa427>
19. Henson JV, Varhabhatla NC, Bebic Z, Kaye AD, **Yong RJ**, Urman RD, Merkow JS. Spinal Cord Stimulation for Painful Diabetic Peripheral Neuropathy: A Systematic Review. *Pain Ther*. 2021 Dec;10(2):895-908. PMID: 34244979, PMCID: PMC8586096, <https://doi.org/10.1007/s40122-021-00282-9>

20. **Yong RJ**, Mullins PM, Bhattacharyya N. Prevalence of chronic pain among adults in the United States. *Pain*. 2022 Feb 1;163(2):e328-e332. PMID: 33990113, <https://doi.org/10.1097/j.pain.0000000000002291>

Other peer-reviewed scholarship

1. Rohan Jotwani, Michael Fiore, Robert Jason Yong, David Hao, Virtual reality for procedural education: Lumbar medial branch radiofrequency neurotomy, *Interventional Pain Medicine*, Volume 1, Issue 1, 2022, 100088, ISSN 2772-5944, <https://doi.org/10.1016/j.inpm.2022.100088>. (<https://www.sciencedirect.com/science/article/pii/S2772594422000796>)
Abstract: Virtual reality (VR) simulation is an emerging tool in medical education. Simulation conducted in VR can reproduce procedural scenarios and allow for immersive interaction with anatomic models. This has the potential to improve understanding of anatomy and concepts relevant to interventional procedures. Here, we present a “proof-of-concept” modeling of lumbar thermal radiofrequency neurotomy through cost-effective, commercially available VR hardware and software. With this technology, we can demonstrate key fluoroscopic views and needle trajectories based on specific recommendations from Spine Intervention Society guidelines. Furthermore, the learner can manipulate the model in multiple 3-dimensional axes to visualize anatomy relevant to key fluoroscopic views. Finally, the content can be exported by recording a live casting stream, thus offering an approach for future content creation and collaboration. VR technology is an emerging educational modality that offers immersive and interactive features that may offer advantages to traditional visual teaching modalities.

Non-peer reviewed scholarship in print or other media:

Reviews, chapters, monographs and editorials

1. **Yong RJ**, Nedeljkovic S. Assessment of pain: Patient evaluation. In: *Pocket Pain Medicine*, Urman RD, Vadivelu N (eds), Philadelphia: Lippincott
2. Tong I, **Yong RJ**. Pain Emergencies: Averting catastrophe through diagnosis and treatment. In: *Fundamentals of Pain Care*. Oxford University Press, 2015
3. Smith J, **Yong RJ**, Nedeljkovic S. “Minimally Invasive Treatments for Spinal Stenosis: Percutaneous Lumbar Decompression.” *Surgical Pain Management*. Oxford University Press, 2016
4. Yazdi C, **Yong RJ**, Nguyen, M. “Endovenous Ablation.” *Surgical Pain Management*. Oxford University Press, 2016

5. Lockhart B, **Yong RJ**. Pharmacology of Pain Transmission and Modulation. In: Pain Medicine: An Essential Review, RJ Yong, Nguyen M, Nelson E, Urman RD (eds), 1st Ed. Switzerland: Springer International Publishing, 2017; p.147-148.
6. Patel M, **Yong RJ**. Corticosteroids. In: Pain Medicine: An Essential Review, RJ Yong, Nguyen M, Nelson E, Urman RD (eds), 1st Ed. Switzerland: Springer International Publishing, 2017; p.181-184
7. Tong I, **Yong RJ**. "Sacroiliac Joint Pain.L5 Dorsal Ramus and S1-S3 Lateral Branch Radiofrequency Ablation. In: Pain Medicine: An Essential Review, RJ Yong, Nguyen M, Nelson E, Urman RD (eds), 1st Ed. Switzerland: Springer International Publishing, 2017; p.245-248
8. Tong YCI, **Yong RJ**. Cervical Facet Injections/Medial Branch Block. In: Pain Medicine: An Essential Review, RJ Yong, Nguyen M, Nelson E, Urman RD (eds), 1st Ed. Switzerland: Springer International Publishing, 2017; p.227-230
9. Tong YCI, **Yong RJ**. Lumbar Medial Branch Radiofrequency Lesioning. In: Pain Medicine: An Essential Review, RJ Yong, Nguyen M, Nelson E, Urman RD (eds), 1st Ed. Switzerland: Springer International Publishing, 2017; p.237-240
10. Tong YCI, **Yong RJ**. Lumbar Transforaminal Epidural Steroid Injection. In: Pain Medicine: An Essential Review, RJ Yong, Nguyen M, Nelson E, Urman RD (eds), 1st Ed. Switzerland: Springer International Publishing, 2017; p.223-226
11. Tong YCI, **Yong RJ**. Sacroiliac Joint Injection. In: Pain Medicine: An Essential Review, RJ Yong, Nguyen M, Nelson E, Urman RD (eds), 1st Ed. Switzerland: Springer International Publishing, 2017; p.241-244
12. **Yong RJ**, Nelson E. "Interlaminar Epidural Steroid Injection: Cervical and Lumbar. In: Pain Medicine: An Essential Review, RJ Yong, Nguyen M, Nelson E, Urman RD (eds), 1st Ed. Switzerland: Springer International Publishing, 2017; p.219-222
13. **Yong RJ**. Issa M. Thoracic facet pain/medial branch blocks.. In: Pain Medicine: An Essential Review, RJ Yong, Nguyen M, Nelson E, Urman RD (eds), 1st Ed. Switzerland: Springer International Publishing, 2017; p.231-232
14. **Yong RJ**. Issa M. Tricyclic antidepressants. In: Pain Medicine: An Essential Review, RJ Yong, Nguyen M, Nelson E, Urman RD (eds), 1st Ed. Switzerland: Springer International Publishing, 2017; p.165-166
15. Saba R, **Yong RJ**, Gilligan C, Rathmell J. Emergencies in the Pain Clinic. In: Bonica's Management of Pain, Ballantyne JC, Fishman SM, Rathmell JP (eds), 5th Ed. Philadelphia: Lippincott, Williams & Wilkins, 2018
16. Lubrano M, Costelloe C, **Yong RJ**. Local Anesthetics and Scalp Blocks. In: Hair Transplant Surgery and Platelet Rich Plasma: Evidence-based Essentials, Lee LN (ed), 1st Ed. Switzerland: Springer International Publishing, 2020, chap 8
17. Tong I, **Yong RJ**, Hogan BB. Pain Emergencies and Life-threatening Complications of Pain Treatments. In: Pain Care Essentials, 1st Ed. Oxford University Press, 2020, chap 13

Books/textbooks for the medical or scientific community

1. RJ Yong, Nguyen M, Nelson E, Urman RD. Pain Medicine: An Essential Review, 1st Ed. Switzerland: Springer International Publishing, 2017
2. Pak D, Yong J, Shah K. Interventional management of chronic visceral pain syndromes. 1st edition, Missouri: Elsevier, 2021

Professional educational materials or reports, in print or other media:

1. Yong R. Brigham and Women's Anesthesia Residency Wiki. BWHAnesthesia.org, 2011
2. Yong R. Brigham and Women's Pain Fellow's Wiki. BWHAnesthesia.org, 2011
3. Yong, RJ www.TheAnswerPage.Com, A web-based daily educational resource for medical professionals. A web-based daily educational resource for medical professionals. Eleventh Annual Medical Education Day, Harvard Medical School, Boston, MA, 2012
4. Yong, RJ. TheAnswerPage.com. Pain, Palliative Care, Opioid Prescribing and Risk Management: The Answer Page, Inc; 2012
5. **Yong RJ.** Cancer Pain: in Pain, Palliative Care, Opioid Prescribing & Risk Management: The Answer Page, Inc. 2015.
6. **Yong RJ.** Cannabidiol Therapy in Cancer Pain and Management: Florida Physicians Low -THC Cannabis Course: Florida Medical Association, Inc 2015

Abstracts, Poster Presentations and Exhibits Presented at Professional Meetings:

1. Nelson ER, Truong QV, Caparo MA, **Yong RJ**, Sarno D, Reducing Radiation Exposure During Interventional Pain Procedures After Procedural Training in a Simulation Environment Using a Cadaveric Model. Poster presented at the 2019 American Academy of Pain Medicine Annual Meeting
2. Pisansky A, **Yong RJ**, Peratikos MB, Weeks, H, Stringer EA, Muller C. Preoperative Opioid Use Associations with Surgical Outcomes, Medical Spending, and Persistent Opioid Use following Elective Spinal Cord Stimulator Implantation in the United States: A Large Retrospective Cohort Study of Administrative Claims Data. American Society of Regional Anesthesiology Annual Conference, 2019. Moderated Poster Presentation
3. Sarno D, Syed R, Olezene CS, **Yong RJ**, Nelson ER, Simulation in Interventional Pain Management Education. American Society of Interventional Pain Physicians Annual Conference, 2019. Poster Session
4. **Yong RJ**, Sarno D, Velez M. Resolution of Chronic Debilitating Headaches and Lumbar Radicular Pain Following Spinal Cord Stimulation and Interspinous Process Decompression: A Case Report. North American Neuromodulation Society, 2020.
5. Fiore M, Galanti G, Park B, Lim S, **Yong RJ**, Gilligan C, Nelson E. Virtual Reality Augmentation to a Pain Medicine Simulation Curriculum. American Academy of Pain Medicine, 2021.

6. Mukherjee V, **Yong RJ**, Janardhanan D, Nelson ER, Zhao E, Gilligan CJ. Interventional Management of Thoracic Pain Secondary to Malignant Pleural Effusion: A Case Report. American Academy of Physical Medicine and Rehabilitation 2021 Annual Assembly – Pain and Spine Medicine. Annual Meeting; Nashville, TN
7. Vu K, Pappy A, Berlin E, Yang A, Sarno D, Nelson E, **Yong RJ**. Comprehensive Simulation Sessions for Interventional Spine Procedure: Preliminary Prospective Results. Spine Intervention Society Annual Meeting, 2022. Poster Session

Narrative Report

As an academic anesthesiologist specializing in pain medicine at Brigham and Women's Hospital, my efforts are focused on developing clinical expertise, innovating pain medicine through novel implantable devices and opioid management strategies, and educating fellows and residents. My major supporting activity involves administrative and institutional service with leadership roles and committee service.

Approximately half of my time is devoted to direct patient care within pain medicine including time spent evaluating patients in clinic, performing office-based procedures, and surgically implanting devices to help manage pain. I spend twenty percent of my time as an anesthesiologist supervising residents and nurse anesthetists with a focus on regional anesthesia and acute post-operative pain management. The remainder of my time is divided among administrative duties including institutional committee service and serving as Chief of Pain Medicine, Medical Director of the Pain Management Center, and Associate Program Director for the Pain Medicine Fellowship.

Clinically, I have developed expertise in surgically implantable technologies for the treatment of chronic pain and opioid management strategies. Since fellowship, I have been fascinated by neuromodulation using spinal cord and peripheral stimulators to modulate pain signals. Using this passion, I have taught fellows and residents extensively on the technology, and introduced the Nevro high frequency stimulator to Brigham and Women's Hospital becoming the first implanting physician in New England. I am now receiving direct referral from across the Northeast for evaluation of neuromodulation and targeted drug delivery using intrathecal pumps. I am currently the Principal Investigator in 3 prospective case-series examining the efficacy of novel neuromodulation technologies. With my focus on neuromodulation, I have been fortunate enough to become the top implanter of spinal cord stimulators in the Northeast.

Given the recent impact of the national opioid epidemic, I have devoted significant time and effort to shaping opioid management strategies. I have been involved in the Harvard Medical School Opiate Ad Hoc committee, the Opioid Management subcommittee, and BCORE Standards committee.

I am continuing to develop my career in research and have joined on as a co-investigator on three clinical research studies. In addition to the neuromodulation studies, I am working on

IRB approval for other studies involving Platelet Rich Plasma and its application to Pain Medicine, tracking outcomes of implantable devices at our center, and using RFID technology to perform Time Driven Activity Based Costing at our Pain Management Center. In response to my personal struggles and those of fellows starting their careers, I conceptualized and was first editor for Pain Medicine: An Essential Review which focuses on relevant clinical pearls.

On a national level, I have been invited to give 4 grand rounds and was invited to serve on the American Board of Anesthesiology MOCA Minute for Pain Medicine question writing committee. Internationally, I participate in 1-2 medical missions per year providing anesthesia and have been invited to give multiple international presentations.

As the founding medical director of the Pain Management Center at Brigham and Women's Faulkner Hospital, I helped grow the pain medicine services at the hospital focusing on the integration of high quality pain management to all areas of the hospital. Our volume tripled to over 400 pain patients per month in the span of 3 years. Due in part to that success, in 2017, I was selected as the Medical Director of the Pain Management Center at Brigham and Women's Hospital. In this role, I am focused on operational efficiency and financial viability. With the early changes I helped manage and develop, our productivity has increased with an improvement in patient satisfaction. The rapid turnaround then led to the appointment as Associate Chief and now interim Chief of the Division of Pain Medicine. I was also elected to serve on the Faculty Board in the Department of Anesthesiology.

As the Associate Program Director for the Pain Management Center at Brigham and Women's Hospital, I am involved with recruitment, curriculum development, and overall management of the 10 fellows per year. My involvement in this role extends to committee service on a hospital and national level with the American Board of Anesthesiology. As a product of our own residency and fellowship, I am appreciative of the extensive curriculum and mentorship by the world renown experts at our institution. I have strived to reciprocate using innovative teaching methods such as the introduction of medical simulation with pain procedures, and I am honored to have my passion in mentorship and teaching reflected in the Pain Fellow's Pain Attending of the Year award for excellence in teaching for 5 of the previous 7 years.

In addition to my clinical work, I have been an active member in our department and the hospital. I was elected to serve on the Medical Staff Executive Committee for Brigham and Women's Faulkner Hospital and currently serve on the Ambulatory Advisory Council at Brigham and Women's Faulkner Hospital and the Office for Multicultural Careers Advisory Committee at the Brigham and Women's Hospital.